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ABSTRACT

The education committee of the Federation of American Societies for Experimental Biology (FASEB) organized a Task Force on Precollege Science Education Programs to develop a strategy for increasing the involvement of scientific research personnel in science program implementation. This report contains the comments and recommendations of the Task Force. Perspectives are offered on how research scientists could participate in the improvement of science and mathematics instruction at the local level. Specific contents include: (1) introductory comments (reviewing previous efforts of the Task Force and explaining workshop goals and format); (2) strategies for involving research scientists in the improvement of science education (listing ways, means, and opportunities for research scientists to interact with precollege science teachers and for scientific organizations to assist teachers); and (3) conclusions and recommendations. A listing of workshop attendees and their affiliations is also provided. (ML)

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STRATEGIES FOR INCREASING INVOLVEMENT OF RESEARCH SCIENTISTS IN IMPLEMENTATION OF INNOVATIVE SCIENCE EDUCATION PROGRAMS

PHASE II

A Report Prepared for the
Educational Research and Improvement Branch
National Institute of Education
United States Department of Education
Washington, D.C. 20202

under
DOE Contract Number 300-83-0294

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by the
Task Force on Precollege Science Education
of the
FASEB Education Committee

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Task Force on Precollege Science Education
of the
FASEB Education Committee

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FOREWORD

The Education Committee of the Federation of American Societies for Experimental Biology (FASEB) consists of representatives of each of the seven constituent societies. The Committee includes in its purpose the responsibility for furnishing guidance and counsel to the Executive Director in representing the Federation's position and initiatives in the area of science education. Furthermore, it is charged with developing recommendations for sound educational programs to be administered by the FASEB staff after approval by the FASEB board. At its meeting on November 18, 1982, the Committee responded favorably to a request from the Office of Educational Research and Improvement (OERI), U.S. Department of Education, that the Federation assist in developing a strategy for increasing direct involvement of the nation's scientific research personnel in the implementation of innovative science education programs in elementary and secondary schools. This continuing effort complements initiatives of many professional, educational, and scientific organizations designed to upgrade the resources and capabilities for teaching of science, mathematics, and technology in the primary and secondary school systems.

As an initial step, the FASEB Education Committee organized a Task Force on Precollege Science Education Programs. The Task Force prepared a report on approaches and opportunities for research scientists to participate in improvement of science and mathematics education at the local level. This position paper (Phase I) was published in March 1983 and dealt with aspects of the topic that could be addressed by the Federation and its member scientists.

One of the major recommendations of the Phase I report was the suggestion that the Task Force explore further what specific activities the Federation and its member scientists might provide that would be considered useful and worthy by secondary school science teachers. To address this topic, the Task Force convened a workshop on November 19, 1984 at Federation Headquarters. Representative middle and high school science teachers and science supervisors met with members of the Task Force to provide their perspective on how their efforts in science education might be augmented or assisted by input of research scientists. Workshop attendees are identified in Section IV.

The workshop deliberations and suggestions are summarized in this report which constitutes Phase II of the FASEB Education Committee's efforts to develop strategies for involvement of research scientists in implementing innovative science education programs in the nation's elementary and secondary schools.

This report contains the comments and recommendations of the Task Force. It has been reviewed by the FASEB Education Committee and the FASEB Executive Director. The assistance of the FASEB staff who organized the workshop and edited this report (S.A. Anderson, K.D. Fisher, M. Marsh, and S.A. Schnell) is acknowledged.

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I. INTRODUCTION

A. BACKGROUND

In March 1983, a Task Force on Precollege Science Education of the FASEB Education Committee published a report on strategies for increasing involvement of research scientists in precollege science education.* In this report the Task Force concluded that national scientific, mathematical, and engineering associations and societies can play an expanded role in communicating needs of the education community to their members, facilitating the channeling of ideas and information from their members to science and mathematics educators, and providing their expertise and resources to interested groups and persons in the local communities. The Task Force also concluded that national scientific, mathematical, and engineering societies should maximize efficient use of available resources, minimize duplication of programs and services, and cooperate among themselves in making available those resources, programs, ideas, and assistance that the education community needs. Where possible, cooperative and collaborative efforts among these organizations should be encouraged and supported in order that local strategies reflect a balanced approach to improvement of precollege science and mathematics education.

In this regard, scientific, mathematical, and engineering societies have expertise and resources that should be focused on enhanced involvement of research scientists in implementing innovative science and mathematics education programs. Finally, the Task Force identified a number of broadly applicable programs, initiatives, and activities which were listed in the Phase I report.

To implement its conclusions, the Task Force made a series of recommendations to the Federation in regard to a role for the FASEB Education Committee as a resource in furthering interest in and support of precollege science education. Specifically, the Task Force recommended:

> Efforts of the FASEB Education Committee should be oriented to those activities and programs that are considered useful and helpful by those professionals who have primary responsibility for precollege science education. Therefore, the FASEB Education Committee should consider an ad hoc meeting with a small representative group of middle and senior high school teachers, particularly those responsible for upper level science courses, to:
>
> (1) determine what specific activities, involvement, or programmatic assistance the Federation and its scientists might provide that are considered optimally useful and worthy;

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* Trump, B.J. 1983. Strategies for Increasing Involvement of Research Scientists in Implemention of Innovative Science Education Programs. Prepared under DOE Contract Number 300-82-0378. 17p. Available from: Federation of American Societies for Experimental Biology, 9650 Rockville Pike, Bethesda, Maryland 20814.

(2) solicit comments on the draft report of the Task Force in regard to specific ways in which research scientists might provide assistance to science teachers.

Such a meeting would provide the Education Committee with a better perspective of the specific opportunities for biologists and research investigators to focus on efforts that are desired. Further, this meeting and the report would serve as a model for other scientific organizations. A meeting and a widely disseminated synoptic report of the meetings' discussions would meet these goals.

B. WORKSHOP ORGANIZATION AND GOALS

The Task Force sought and received support for a workshop from the Educational Research and Improvement Branch, National Institute of Education. Members of the Task Force and FASEB staff sought assistance of local Boards of Education, science educators, and school principals in identifying experienced science teachers who could provide a perspective on what they, as educators and scientists, would suggest as practical and viable ways in which research scientists could serve as resource persons to elementary and secondary school teachers. These individuals were invited to the Federation to discuss their views and recommendations with members of the Task Force. They were asked to address the following questions:

- How can research scientists help with precollege science education?
- What existing mechanisms and helpful programs are you aware of or using?
- What are the problem areas in science education where research scientists might help?
- What new mechanisms do you suggest for heightened interactions between precollege science educators and research scientists?

The workshop was held November 19, 1983 at the Federation facilities. Attendees and their affiliation are noted in Section IV of this report. The informal discussions developed an exceedingly good rapport among attendees and led to a series of both frank and penetrating suggestions on how research scientists and scientific organizations might lend their expertise and resources to improving precollege science education.

As might be anticipated from the disciplinary orientation of Task Force members, the major points of discussion involved elementary and secondary school teaching of biological science. However, the suggestions and recommendations of the workshop participants are not unique to biology. Indeed, they include a wide range of activities and approaches to involvement of research scientists. The Task Force notes also that its ideas on how research scientists might determine what they could do are not unique either. In a recent guide to

chapters and clubs on science and mathematics education*, Sigma Xi, The Scientific Research Society suggested that interested parties begin by listening to teachers. The remainder of this report is what the FASEB Task Force on Precollege Science Education heard when it sat down and listened to the science teachers. Their suggestions and ideas have universal merit in the common goal of improving science education in the nation's primary and secondary schools.

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* Anonymous. 1984. Science and Mathematics Education: A Guide for Chapters and Clubs. 62p. Available from: Sigma Xi, The Scientific Research Society, 345 Whitney Avenue, New Haven, Connecticut 06511.

II. STRATEGIES FOR INVOLVING RESEARCH SCIENTISTS IN IMPROVEMENT OF SCIENCE EDUCATION

A. OPPORTUNITIES FOR RESEARCH SCIENTISTS

In a previous report of the Task Force (see footnote on p.1), members developed a listing of possible ways and means by which research scientists might interact with precollege science teachers. This listing, reprinted below, represented their ideas on the scope of activities that could be undertaken by individual scientists, research teams, departments, or institutions actively engaged in research. The Task Force recommended (with no order of priority intended by the order):

1. Interact with science teachers and educators as professionals by extending invitations to seminars, gifts of surplus journals and equipment, etc.

2. Cooperate with academic and public science educators, and with other science and education organizations, to synergistically build a balanced approach to science and mathematics education in the primary and secondary grades.

3. Distribute materials such as information, brochures, reports, or surplus journals, books, or equipment from laboratories and professional organizations to science teachers in local school systems.

4. Invite participation of science teachers in departmental seminars, special lectures, demonstration programs, tours, etc.

5. Organize local industrial and academic resource scientists to provide opportunities for science teachers and students, such as:

   - participation in workshops on recent advances in biology
   - part-time employment in the research setting
   - preparation of a directory of locally available resource scientists
   - summer research participation programs
   - tours of research facilities.

6. Organize local scientific resource persons as support groups providing data or information as requested by science educators.

7. Participate in programs developed by science educators to upgrade science education for students in general and the gifted in particular and in efforts to raise public awareness of the role of science and mathematics in contemporary society.

8. Participate in efforts of universities and colleges to strengthen the education and training of primary and secondary school science teachers.

9. Promote practical experience as an important component of science education by means of opportunities for employment, lectures, tours, preparation of laboratory exercises, demonstrations, etc.

10. Encourage involvement and provide recognition for colleagues and employees who become involved in efforts to enhance primary and secondary school science programs.

11. Support or initiate efforts to identify and support awards for excellence in teaching science in local schools.

12. Volunteer to participate or become involved as a:

    - resource biologist for a class, teacher, science department, curriculum committee, school subdivision, school board, or other organizations with programs designed to enhance science education.

    - speaker; as a member of a visiting scientist program, such as a FASEB Speakers' Bureau; or as an individual who lectures to teachers, curriculum committees, parent/teacher groups, who discusses issues with students, who provides input to school departments, etc.

    - advisor to teachers, counselors, and students.

    - workshop participant in short courses, training sessions, academic courses, etc.

    - worker in local efforts to marshall communities' scientific resources to bear on local needs. Represent or facilitate cooperative efforts of professional groups, universities, colleges, industrial laboratories, science libraries, research departments, scientific societies, civic clubs, service clubs, parent/teacher associations, fraternal organizations, etc.

In discussing these recommendations, the science teachers attending the workshop endorsed their intent and scope without reservation. However, they pointed out that such activities are not unique or novel. Indeed, they were quick to point out that:

- many of these activities were already in place and active in a number of communities; nevertheless, additional opportunities existed in a large number of rural and urban communities;

- most of these ideas are fundamentally so ordinary or readily accomplished that they are overlooked by research scientists and educators alike;

- most of these require little or no fiscal input;

- the focus of these suggestions on interaction with teachers and students is most appropriate and, at the local level, is where individual scientists can be a unique and contributory resource to precollege science education.

Additional suggestions on opportunities for individual scientists identified by the workshop participants include:

13. Serve as mentors for teachers and selected students. Several communities and school systems have both informal and formal means by which research investigators, individually or collectively, participate in programs such as Adopt-a-School, Adopt-a-Class, Adopt-a-Student, etc.

14. Solicit and coordinate donations of equipment, supplies, books, and other resource materials from colleagues, employers, service organizations, and other sources.

15. Support the concept of corporate, community, or private support for minigrants to individual teachers, school departments, or curriculum innovations in science teaching. Such grants could be for study leave, equipment, visual aids, resource materials, or other needs of the teacher or science department.

16. Initiate meetings of science teachers with other FASEB Society members within the individual community or local area.

17. Organize and participate in stimulating further lines of communication between educators, educational administrators, and research scientists by means of small group meetings, seminars, or workshops. Within their respective disciplines, research scientists are a resource of information on significant breakthroughs, trends, and contemporary thought on science and technology. Such information is often not readily available to science teachers.

18. Encourage out of school opportunities for experience in research settings. These might range from short visits to employment opportunities.

Finally, the most useful suggestion of the workshop attendees is perhaps the most easily overlooked. That is, utilize the format of this workshop to initiate or expand support for greater contact between research scientists and science teachers in local primary and secondary schools. Workshops or informal discussions such as this one could take place at locations throughout the country at the instigation of one interested person. The investment in time and effort would be minimal, but the return in terms of enhanced communication and opportunities would be phenomenal. In the words of one participant, "Consider what would happen if 28,000 Federation Society members organized a workshop such as this in 28,000 different schools around the country?"

Workshop attendees also pointed out that any and all efforts to stimulate communication between scientists and teachers at the local level was a fundamentally useful adjunct to precollege science education. This concept, while discussed in the context of opportunities for individual scientists, applies equally to institutions of higher learning, scientific societies, and similar organizations.

Despite the general agreement on the need for greater involvement of individual scientists and the large number of opportunities for interaction, workshop attendees noted issues which need to be recognized and kept in perspective. These include:

- Science education from primary to secondary school should be a continuing process; often it is not. Indeed within schools and school systems it may be uneven and/or fragmented. Thus, it is important for scientists who desire to contribute their time and talent to learn where resources are needed and to respond accordingly, if possible. Patience and understanding are helpful attributes.

- Similarly, the need for what an individual might offer or provide is continuous but variable. The specific needs may vary from a pH meter in the fall semester to seminar invitations or summer employment the next year; but the need, in a generic sense, is continuous. Thus, sustained support is genuinely appreciated; one-time offers are less helpful.

- There are, in a number of urban communities, a plethora of scientific, service, and similar organizations as well as individuals who are supporting precollege science and mathematics education in a variety of ways. More often than not, teachers, administrators, and the providers are unaware of each others' efforts. Mechanisms for communication among all interested parties at the local level is becoming an important and critical need. Such is not the case in many rural areas where the number of interested scientists, organizations, and other resource groups are fewer. Still, rural schools also need communication on what resources might be available at the county or state level. As noted by one participant, "Urban school or rural one, the name of the game is the same. Exposure, exposure, exposure. Communicate and inform both educators and scientists of the programs and activities already in existence. And when you do, do it again and again!"

B. OPPORTUNITIES FOR SCIENTIFIC ORGANIZATIONS

Workshop participants suggested that the Federation, its constituent societies, and other scientific organizations can play a significant role in communicating information, serving as a resource, coordinating and supporting the efforts of its members, and cooperating with other scientific and technological groups in the common goal of bringing their resources and expertise to bear on the improvement of precollege science education.

In its previous report, the Task Force suggested four means by which the Federation and other scientific organizations might fulfill these functions. The four approaches were:

(1) Communicating information on science and scientific disciplines to the science education community and general public.

(2) Communicating the needs of the science education community for involvement of research scientists in precollege science education as well as opportunities and ideas for involvement at the local level.

(3) Serving as a resource or clearinghouse for those individuals or groups in the science education community who are seeking the involvement or expertise of research scientists in the several respective disciplines.

(4) Providing resource material on potential opportunities, successful ventures, model programs, and related innovative techniques to research scientists who wish to become more involved in primary and secondary science education.

In discussing these approaches, workshop participants made a number of specific suggestions on how, in their view, these might be addressed by national and local chapters or groups of members. The following paragraphs exemplify the range of ideas discussed.

- Encourage, sponsor, and otherwise support the involvement of members as individuals in ways detailed in the previous section.

- Establish a continuing newsletter or similar publication to identify recent research findings of significance, resources available, and training and educational opportunities. Or, develop a means by which such information provided by FASEB might be incorporated into publications now reaching students, teachers, public officials, and other interested parties. A separate newsletter or publication or at least special issues devoted to education should be considered.

- Prepare visual presentations (slides, television tapes, filmstrips, etc.) for use by schools and the public that provide coverage of such topics as a perspective on what research is, how it is conducted, what questions are being addressed by various scientific disciplines, and what careers are available to interested students.

- Expand the organization's impact on public perception of science and science education in an organized and sustained manner. For example, FASEB is a major national scientific consortium composed of well-educated and highly skilled scientists; the organization has considerable influence throughout the country. FASEB could set a framework in place to express to state school boards, state

superintendents, national secondary science magazines, and journals, the position of the biological science community on precollege science education. The Education Committee or Task Forces could establish a newsletter and communications network to prepare information and position statements as an organization that discuss such issues as support for strengthening the background of science teachers; legislative support for strengthening science curricula and improving teacher science preparation; and, support for federal funding of teacher and student summer institutes. These statements should be widely disseminated among the members and to the public by appropriate means.

- Develop a roster of members who are willing to contribute time and expertise to schools, science coordinators and supervisors, as well as local and state educational systems. Retired scientists should be an important component of this roster because of their wealth of experience and knowledge. Get this information to responsible individuals in the educational system at the appropriate level. Follow-up on the results and monitor progress. This should be a sustained multi-year effort.

- Consider a more active role for the organization in disseminating information on, developing positions on, and testifying in behalf (or against) legislation in the educational arena. If science has an interest in science education, it should make its opinions and views known at the state and national level by public affairs efforts on behalf of science education.

- Develop or support the development of a clearinghouse for scientific information of interest to precollege science teachers. Utilize members as resource persons in developing topical information. Direct telephone via a toll-free line or by means of direct access online communication would be expensive but worthy of consideration if an extended program is developed.

- Establish a directory of resource scientists who are willing to participate in aspects of precollege science education, such as sources of information on specific scientific topics; sources of referrals to other investigators; input on curriculum content; sources of information on laboratory facilities, experiments, equipment, costs, etc. Building and maintaining a directory of resource scientists could be patterned after FASEB's "Visiting Scientists for Minority Institutions." An important resource to be included would be retired scientists.

- Develop a pilot or model program for mentorships and internships that would include support for and recognition of interactions of research scientists and science teachers. Such a program would probably require outside support, but FASEB has the human resources and ability to initiate and coordinate such an effort.

- In concert with national organizations of science teachers, educational administrators, and others as appropriate, develop guidelines on a jointly approved statement on ways to contact and interact with science teachers in the primary and secondary schools. For example, the National Science Supervisors Association has a system for local contacts already in place.

- Develop pilot or model programs that stimulate further the lines of communication between educators and research scientists via seminars/speakers/symposiums/workshops/demonstrations and summer laboratory work experience. Brief updates are very useful and effective. Significant trends/research and technologies which have implications for science teaching should be included. Again, outside financial support may be required, but FASEB has the ability to undertake such a program.

- Several scientific societies, including the American Society of Biological Chemists, now sponsor and support minigrants to teachers for educational endeavors and equipment and supplies for courses and advanced student course work. These efforts should be expanded. Funding of minigrant proposals by science teachers on a local level by national scientific societies is a dramatic and readily identified policy statement regarding the importance of increasing science education and opportunity for young people.

- Prepare and disseminate to members and the educational community an annual directory of opportunities for educational enrichment within the appropriate biological disciplines that includes summer research opportunities for teachers, summer and work release opportunities for students interested in careers in research, degree programs and special courses in specific topic areas, workshops on specific subjects, and resources for classroom presentation, laboratory equipment, reference materials, scientific books, journals, etc.

- Develop a model program for interested high school students to broaden their background in science to obtain career counseling. For example, the "Saturday Open College" is a tuition-free non-profit institution being organized in the Maryland suburbs of Washington, D.C. by an offshoot of AARP's Senior Scientists and Engineers Volunteer Project (SSEVP). The purpose of the college is to assist high school students and other young people broaden their intellectual backgrounds and provide career counseling. The Saturday classes are held on the campus of Montgomery College in Rockville and the University of Maryland in College Park. The majority of volunteer instructors are retired scientists and engineers. The College is part of the AARP/SSEVP demonstration project in the Washington, D.C. metropolitan area, designed to tap the skills of retired professionals, particularly scientists and engineers, for community service. FASEB could encourage member involvement in such programs or could develop models of similar programs for use by members at the local level.

Finally, one additional suggestion relates to the ongoing programs and efforts of FASEB or other scientific societies that are actively seeking to make their resources available to the science education community. That is, make provision for permanent inclusion of precollege science educators on Education Committees and Task Forces that address issues and opportunities in primary and secondary science education.

III. CONCLUSIONS AND RECOMMENDATIONS

Workshop participants agreed that both the discussions of the group and informal conversations were both personally and professionally rewarding. The members of the FASEB Education Committee Task Force learned of a number of opportunities and activities for involvement of research investigators and their scientific organizations in precollege science teaching. The science teachers and administrators found a receptive audience willing to listen to suggestions on ways and means for research scientists to participate actively in precollege science education.

Science teachers also provided the Task Force with a useful perspective on actual needs of the science teacher facing students, grades K-12, whose abiding interests in biology, chemistry, mathematics, and physics vary from highly motivated to none. Also discussed in some detail were aspects of precollege science teaching beyond the workshop scope such as science teacher training at the college level, financial and related aspects of employment as science teachers, and the pressures of teaching science in the contemporary public and private school systems of the United States. These discussions served to confirm for Task Force members the complexity of the educational process in which new and developing minds are exposed to the world of science and scientific research.

A number of specific recommendations for individuals and organizations have been identified in the previous section of this workshop report. General conclusions and recommendations worthy of stating are as follows:

- The workshop was highly successful in terms of its purpose and goals.

- The format of the workshop should be utilized by others to foster communication and interaction among precollege science teachers and research investigators.

- Copies of this report should be widely distributed in the scientific and educational community. Recipients of the report should be encouraged to share copies as much as possible. [NOTE: The Federation claims no copyright on this report and encourages reproduction and dissemination provided that such activities acknowledge the source (see title page) and that such copies are at no cost to recipients].

- The Federation should cooperate and collaborate with other national organizations in developing a multifaceted but balanced approach to improvement of precollege education in science and mathematics. That is, efforts to enhance education in mathematics, biology, chemistry, physics, and engineering technologies must be balanced and mutually supportive. The Education Committee and its Task Forces should play a central role in representing the Federation in such activities.

- Workshop participants also recommended that FASEB undertake to maintain communication among participants and that the group meet subsequently in 2 or 3 years to evaluate programs of the Federation and the status of precollege science education.

- The FASEB Education Committee should utilize the workshop output to build a strong programmatic thrust in fostering and supporting the enhancement of precollege science teaching in biology.

- The FASEB Education Committee should expand its efforts to communicate to its constituent societies and their members the needs of and issues faced by the precollege science education community. These efforts should include communications, programs, and leadership in making the expertise of members more available at the local and community level.

- Workshop participants recognized that FASEB represented a unique link between research scientists and the precollege teaching community. They encouraged the development of a strong component of the FASEB Education Committee in the form of an Education Officer who could serve as a durable information and resource connecting link between FASEB and secondary school science. The need for a connective structure to implement many of the findings of the workshop is the only impediment to the initiation of a nationwide effort that would release the Federation's scientific resources which have great potential for impact on the education of this nation's youth.

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